AP Biology, Semester 1
Unit Quiz: Cell Structure and Function
Instructor Version

Section I: Multiple-Choice Questions
Scoring: 3 points each, 60 points total

1.	**A**
2.	**D**
3.	**D**
4.	**E**
5.	**B**
6.	**A**
7.	**C**
8.	**B**
9.	**B**
10.	**E**

11.	**A**
12.	**E**
13.	**E**
14.	**C**
15.	**E**
16.	**D**
17.	**D**
18.	**A**
19.	**C**
20.	**B**

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Section II: Free-Response Questions
Scoring: 20 points each, 40 points total

1. The relationship between structure and function is an important theme in biology. Select four of the following cellular structures or organelles. Describe its function and explain how its structure is related to its function (5 points each).

   A. Lysosome
   ANSWER:
   Function (2 points): Lysosomes are responsible for the breakdown of food molecules (carbohydrates, fats, and proteins).

   Structure (2 points): Lysosomes are membrane-enclosed sacs containing digestive enzymes. The lysosomal fluid is acidic to help enzymes function.

   Relationship (1 point): Isolating these enzymes in a special environment keeps them away from the rest of the cell. The fact that they function best at low pH means that even if they do get out into the cytosol, they won't be very active.

   B. Cytoskeleton
   Function (2 points): The cytoskeleton provides the structural framework for the cell, anchors organelles in place, and participates in cell movement and division.

   Structure (2 points): The cytoskeleton consists of microtubules, microfilaments, and intermediate filaments, each with its own unique protein structure.

   Relationship (1 point): The proteins used in the cytoskeleton components are fibrous proteins, as opposed to globular proteins. (*Note: Draws on Unit 1 knowledge.*)

   C. Plasma membrane
   Function (2 points): The plasma membrane separates the cell from its environment, controls the movement of molecules, catalyzes biological reactions, and transmits information via signal transduction. *(Note: Need all four functions for full credit.)*

   Structure (2 points): The structure of the plasma membrane is described by the fluid mosaic model. Membranes are phospholipid bilayers containing proteins that can move laterally in the membrane. The bilayer is oriented with the hydrophobic tails toward the interior. Membranes are asymmetrical, with the carbohydrate portion of glycoproteins and glycolipids oriented to the exterior.

   Relationship (1 point): The ability of proteins to move in the membrane is critical for their various functions. In addition, the hydrophobic core of the membrane is a natural barrier to the movement of water and aqueous substances from one side to the other.

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D. Cytosol

Function (2 points): The cytosol provides a medium in which organelles can float and in which chemical reactions can occur.

Structure (2 points): The cytosol is an aqueous fluid containing ions, small molecules, and soluble macromolecules.

Relationship (1 point): The substances in the cytosol help maintain the proper cell pH and ionic concentration. Water is essential for dissolving the ions and molecules, as well as for carrying out certain chemical reactions.

E. Endoplasmic reticulum

Function (2 points): The endoplasmic reticulum is involved in protein synthesis (via ribosomes) and in the synthesis and breakdown of small molecules.

Structure (2 points): The ER is a membranous organelle. It's located adjacent to the nucleus so that ribosomes can easily migrate there. There are two types of ER: rough ER (containing ribosomes) and smooth ER (containing no ribosomes).

Relationship (1 point): The membranes provide support for the ribosomes in the rough ER and for the enzymes found in the smooth ER.

2. Diffusion and osmosis play a critical role in the function of a cell. Dialysis is an important laboratory application of osmosis. In one experiment, a mixture of glucose and starch was placed inside a bag of dialysis tubing. The tubing allows the passage of molecules whose molecular mass is 5000 kD or less. Distilled water was placed in a beaker, outside the dialysis bag. The mixture in the tubing and the distilled water outside the tubing were tested for the presence of glucose and starch at several time points.

   Complete the table below, using – for molecules not present, + for present molecules, and ++ for a strong presence of molecules. Explain your reasoning in the space below the table. Keep in mind that glucose is a relatively small molecule, while starch is a macromolecule. Each table entry below is worth 1 point (12 points total).

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Time:	Inside tubing:		Outside tubing:	
	Glucose	Starch	Glucose	Starch
0	++	++	–	–
30 min	++ (or +)	++	+	–
60 min	+	++	+	–

NOTE: The final answer for glucose should be the same inside and outside the tubing.

Explanation: *(Note: Explanations must be consistent with answers above for full credit.)*

Basic concept: Glucose is a relatively small molecule (6 carbons), and starch is a macromolecule. *(2 points)*

Starch behavior: Starch is initially inside the tubing, so it yields a positive result. It's too large to diffuse through the tubing, so the result stays constant inside the tubing (strong positive result) and negative outside the tubing (negative result). *(3 points)*

Glucose behavior: Glucose initially yields a strong positive result inside the tubing and a negative result outside the tubing. It's small enough to diffuse through the tubing. Once diffusion begins, there is a positive result for glucose outside the tubing. Depending on how much has diffused out, there is either a strong positive or a positive result inside the tubing. Once equilibrium is reached, the result should be the same inside the tubing and outside the tubing. *(3 points)*

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